

WHAT IS CLAIMED IS:

- 1           1. A magnetoresistive sensor comprising:  
2                 a stack of magnetoresistive layers including an anti-ferromagnetic layer, a pinned  
3                 layer, a non-magnetic layer, and a free layer;  
4                 an underlayer of said stack of magnetoresistive layers;  
5                 a magnetic domain control film; and  
6                 a pair of electrode films for supplying current to said stack of magnetoresistive  
7                 layers;  
8                 wherein a center position of an upper surface and a lower surface of said magnetic  
9                 domain control film is positioned within a range of an upper surface and a lower surface of said  
10               free layer; and  
11                 further comprising:  
12                 an underlayer formed below said magnetic domain control film; and  
13                 an amorphous metal film layer formed below said underlayer for controlling  
14                 crystallization of said underlayer.
  
- 1           2. A magnetoresistive sensor according to claim 1, wherein  
2                 said stack of magnetoresistive layers comprises said underlayer, said anti-  
3                 ferromagnetic layer, said pinned layer, said non-magnetic layer, said free layer and a protection  
4                 layer formed in this order from the lower layer to the upper layer.
  
- 1           3. A magnetoresistive sensor according to claim 1, wherein  
2                 said stack of magnetoresistive layers comprises said underlayer, said anti-  
3                 ferromagnetic layer, said pinned layer, said non-magnetic layer, said free layer, said upper non-  
4                 magnetic layer, said upper pinned layer, said upper anti-ferromagnetic layer and a protection  
5                 layer formed in this order from the lower layer to the upper layer.
  
- 1           4. A magnetoresistive sensor according to claim 1, wherein  
2                 said stack of magnetoresistive layers comprises said underlayer, said free layer,  
3                 said upper non-magnetic layer, said upper pinned layer, said upper anti-ferromagnetic layer and a  
4                 protection layer formed in this order from the lower layer to the upper layer.

1           5. A magnetoresistive sensor according to claim 1, wherein  
2           said amorphous metal film layer is formed on any one of surfaces within a range  
3           from a lower surface of said underlayer to an upper surface of said non-magnetic layer of said  
4           stack of magnetoresistive layers.

1           6. A magnetoresistive sensor according to claim 1, wherein  
2           said magnetoresistive sensor has a structure in which a lower surface of said free  
3           layer is flush with a lower surface of said magnetic domain control film, and a bias magnetic  
4           field of said magnetic domain control film is mainly applied to said free layer.

1           7. A magnetoresistive sensor according to claim 6, wherein  
2           said underlayer is formed of Cr or Cr alloy and comprise a body-centered cubic  
3           lattice (BCC) polycrystal thin film, and polycrystal orientation to formed plane is isometric  
4           random crystal orientation having no particular crystal orientation.

1           8. A magnetoresistive sensor according to claim 1, wherein  
2           said magnetic domain control film is formed of a Co alloy film, said underlayer  
3           disposed below said magnetic control film controls a crystallization state of said magnetic  
4           domain control film, and said amorphous metal film layer controls a crystallization state of said  
5           underlayer.

1           9. A magnetoresistive sensor according to claim 1, wherein  
2           said magnetic domain control film is formed of a Co alloy film, said underlayer is  
3           formed of a Cr or Cr alloy film, and said amorphous metal film layer is formed of an Ni series  
4           alloy or Co series alloy film.

1           10. A magnetoresistive head constituted by using a magnetoresistive sensor  
2           according to claim 1.

1           11. A magnetoresistive sensor comprising:  
2           a stack of magnetoresistive layers including an anti-ferromagnetic layer, a pinned  
3           layer, a non-magnetic layer, and a free layer;  
4           an underlayer of said stack of magnetoresistive layers;

5                   a magnetic domain control film; and  
6                   a pair of electrode films for supplying current to said stack of magnetoresistive  
7                   layers;  
8                   wherein a center position of an upper surface and a lower surface of said free  
9                   layer is positioned within range of an upper surface and a lower surface at a position near an end  
10                  of said magnetic domain control film; and  
11                  further comprising:  
12                  an underlayer formed below said magnetic domain control film and  
13                  an amorphous metal film layer formed below said underlayer for controlling  
14                  crystallization state of said underlayer.

1                 12.    A magnetoresistive sensor according to claim 11, wherein  
2                   said stack of magnetoresistive layers comprises said underlayer, said anti-  
3                   ferromagnetic layer, said pinned layer, said non-magnetic layer, said free layer and a protection  
4                   layer formed in this order from the lower layer to the upper layer.

1                 13.    A magnetoresistive sensor according to claim 11, wherein  
2                   said stack of magnetoresistive layers comprises said underlayer, said anti-  
3                   ferromagnetic layer, said pinned layer, said non-magnetic layer, said free layer, said upper non-  
4                   magnetic layer, said upper pinned layer, said upper anti-ferromagnetic layer and a protection  
5                   layer formed in this order from the lower layer to the upper layer.

1                 14.    A magnetoresistive sensor according to claim 11, wherein  
2                   said stack of magnetoresistive layers comprises said underlayer, said free layer,  
3                   said upper non-magnetic layer, said upper pinned layer, said upper anti-ferromagnetic layer and a  
4                   protection layer formed in this order from the lower layer to the upper layer.

1                 15.    A magnetoresistive sensor according to claim 11, wherein  
2                   said amorphous metal film layer is formed on any one of surfaces within a range  
3                   from a lower surface of said underlayer to an upper surface of said non-magnetic layer of said  
4                   stack of magnetoresistive layers.

1           16. A magnetoresistive sensor according to claim 11, wherein  
2           said magnetoresistive sensor has a structure in which a lower surface of said free  
3           layer is flush with a lower surface of said magnetic domain control film, and a bias magnetic  
4           field of said magnetic domain control film is mainly applied to said free layer.

1           17. A magnetoresistive sensor according to claim 16, wherein  
2           said underlayer is formed of Cr or Cr alloy and comprise a body-centered cubic  
3           lattice (BCC) polycrystal thin film, and polycrystal orientation to formed plane is isometric  
4           random crystal orientation having no particular crystal orientation.

1           18. A magnetoresistive sensor according to claim 11, wherein  
2           said magnetic domain control film is formed of a Co alloy film, said underlayer  
3           disposed below said magnetic control film controls a crystallization state of said magnetic  
4           domain control film, and said amorphous metal film layer controls a crystallization state of said  
5           underlayer.

1           19. A magnetoresistive sensor according to claim 11, wherein  
2           said magnetic domain control film is formed of a Co alloy film, said underlayer is  
3           formed of a Cr or Cr alloy film, and said amorphous metal film layer is formed of an Ni series  
4           alloy or Co series alloy film.

1           20. A magnetoresistive head constituted by using a magnetoresistive sensor  
2           according to claim 11.

1           21. A method of manufacturing a magnetoresistive sensor comprising:  
2           (1) forming a multi-layered film containing an anti-ferromagnetic layer, a pinned  
3           layer, a non-magnetic layer and a free layer continuously and collectively in a vacuum on a  
4           substrate;  
5           (2) applying a lift-off resist to form a track width on said continuous film;  
6           (3) removing a region not applied with said lift-off resist to said non-magnetic  
7           layer, to said pinned layer, to said anti-ferromagnetic layer, or to an intermediate layer of said  
8           anti-ferromagnetic layer by utilizing ion beams or the like with a good reproducibility;

9                             (4) forming an amorphous layer, an underlayer, a magnetic domain control layer  
10          and an electrode film layer at a region in which a portion of said multi-layered film is removed;  
11          and

12                             (5) removing said resist for lift-off.

1                             22.       A method of manufacturing a magnetoresistive sensor according to claim  
2          21, wherein

3                             forming said amorphous metal film layer, a surface oxidation layer of said  
4          amorphous metal film layer, said underlayer, said magnetic domain control film and said  
5          electrode film are conducted continuously in one identical vacuum vessel.